



RECEIVED
NOV 19 2003
TC 1700

Circle Only One Area of Technology
Applicable to this Invention

REC'D [REDACTED]
0005545

ETCH/SiC
0916

AIT	AKT/TFT	CMP	CVET/CORP
DCVD	EMET	EPI/HTF	ESHO
HCVD	MCVD	MICR	<u>HDP ETCH</u>
PLAT	PVD	RTP	

INVENTION ALERT FORM

(Please use separate attachments for any answers that don't fit on the form, especially for questions 6-8. If the answer to a question is "none", please write "none" rather than leaving the answer blank.)

1. Today's date: [REDACTED]
2. Title of Invention: HIGH HARD MASK SELECTIVITY TUNGSTEN
ETCH USING NF₃/C₆ CHEMISTRY
3. Provide the following information for EACH inventor:

Inventor #1

Name: Gene H. Lee
Telephone: (408) 437-9515 (hm) (408) 584-0269 (business)
Job Title: Process Engineer
Citizenship: U.S.
Home Address: 1241 Briarleaf Cir, S.J. 95131
Boss's Name: Nam-Hun Kim
Boss's Job Title: Sr Engineering Manager
His/Her Boss's Name: Dragan Podlesnik
His/Her Boss's Job Title: General Manager
Product Group: Silicon Etch

Inventor #2

Name: NAM-HUN KIM
Telephone: 408-584-0225
Job Title: Sr. Eng. Mgr
Citizenship: Korea
Home Address: 7767 Lilac Way, Cupertino, CA 95014
Boss's Name: Dragan Podlesnik
Boss's Job Title: General Mgr of Silicon Etch
His/Her Boss's Name: Kevin Fairbairn
His/Her Boss's Job Title: VP
Product Group: Silicon Etch

Inventor #3

Name: _____
Telephone: _____
Job Title: _____
Citizenship: _____
Home Address: _____
Boss's Name: _____
Boss's Job Title: _____
His/Her Boss's Name: _____
His/Her Boss's Job Title: _____
Product Group: _____

Inventor #4

Name: _____
Telephone: _____
Job Title: _____
Citizenship: _____
Home Address: _____
Boss's Name: _____
Boss's Job Title: _____
His/Her Boss's Name: _____
His/Her Boss's Job Title: _____
Product Group: _____

Inventor #5

Name: _____
Telephone: _____
Job Title: _____
Citizenship: _____
Home Address: _____
Boss's Name: _____
Boss's Job Title: _____
His/Her Boss's Name: _____
His/Her Boss's Job Title: _____
Product Group: _____

Inventor #6

Name: _____
Telephone: _____
Job Title: _____
Citizenship: _____
Home Address: _____
Boss's Name: _____
Boss's Job Title: _____
His/Her Boss's Name: _____
His/Her Boss's Job Title: _____
Product Group: _____

Inventor #7

Name: _____
Telephone: _____
Job Title: _____
Citizenship: _____
Home Address: _____
Boss's Name: _____
Boss's Job Title: _____
His/Her Boss's Name: _____
His/Her Boss's Job Title: _____
Product Group: _____

4. Earliest dates and model names of all Applied products incorporating the invention which have been offered for sale or are expected to be offered for sale

DPS poly-etch chamber

5. If invention has been demonstrated or described to persons other than Applied employees, for each disclosure please provide the earliest date, name of company, and brief description of what information was disclosed and purpose of the disclosures.

Hyundai - process chemistry was disclosed for demo update

Samsung - process recipe was disclosed to resolve process tuning issues

6. If disclosures as in question (4) are expected to occur within the next 12 months, please provide the anticipated date, type of information, and purpose of the disclosure.

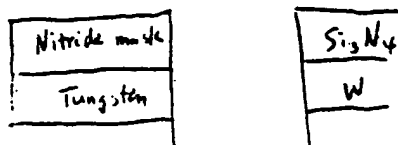
NONE

7. Describe the invention, preferably with reference to drawings.

A novel recipe has been developed to anisotropically etch tungsten film while maintaining higher selectivity to Nitride (Si_3N_4) hardmask than other typical fluorine based chemistries. The challenges of etching tungsten are producing vertically etched profiles with no CD gain or re-entrant profile, while maintaining high selectivity to Nitride mask. With NF_3/Cl_2 based chemistry, typical selectivity to Si_3N_4 mask is $>2.5:1$. Using other F-based chemistries (at low temperatures) the W: Si_3N_4 selectivity is $<1:1$. If Si_3ON (Silicon oxy-nitride) mask is used, then the selectivity can be higher with NF_3/Cl_2 based chemistry.

A proper ratio of NF_3 gas to Cl_2 gas will provide the necessary reactants to remove the tungsten film while providing passivation on the tungsten sidewall to prevent lateral etch.

The patterned tungsten film can be used as conducting material for transistor gates and DRAM bit-line applications.



8. List each feature of the invention which you consider novel and nonobvious. Describe the advantages of each novel feature in comparison with the state-of-the-art approaches which are closest to your invention.

see attachment

9. Describe any other known designs, or processes, whether actually implemented or merely proposed in a publication, which could be considered similar to your invention or which constitute the state-of-the-art which your invention improved upon.

NONE

10. Signature, date, and printed name of each inventor plus two witnesses who have read and understood this Invention Alert form.

Inventor #1: *[Signature]* Date: ██████████

Inventor #2: *Nathan K...* Date: ██████████

Inventor #3: _____ Date: _____

Inventor #4: _____ Date: _____

Inventor #5: _____ Date: _____

Inventor #6: _____ Date: _____

Inventor #7: _____ Date: _____

Witness #1: _____ Date: _____

Witness #2: _____ Date: _____

Rev. ██████████
RJS:aca

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The challenge of etching tungsten film at standard gate process temperatures (~50C), is to achieve vertical profiles with no line width (active area) gain.

1) High W:Nit selectivity:

Etching with other fluorine based chemistries (ie: CF₄, CF₄/Cl₂, CF₄/Cl₂/O₂, SF₆, SF₆/N₂, SF₆/Cl₂/N₂, NF₃/O₂/Cl₂, etc), it may be possible to achieve vertical profiles, but the selectivity of tungsten to the nitride or silicon oxynitride mask is relatively poor (~1:1). With NF₃/Cl₂ chemistry, vertical profiles can be obtained with W:Nit selectivity of >2.5:1.

2) Vertical tungsten profile:

Or, mask selectivity may be higher (~2:1) with other chemistries, but the tungsten profile may be re-entrant or tapered. Vertical tungsten profiles can be obtained with NF₃/Cl₂ chemistry.

Other gas additives may be included for added sidewall passivation.

3) No CD line gain:

Tungsten profile is vertical, so there is no CD gain or loss.